Academic Course Description

BHARATH UNIVERSITY

Faculty of Engineering and Technology

Department of Mechanical Engineering

BME 005 DESIGN OF HEAT EXCHANGERS

Sixth Semester, 2015-16 (Even Semester)

Course (catalog) description

To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications

Compulsory/Elective course: Elective for Mechanical students

Credit& contact hours : 3 & 45

Course Coordinator : Mr.Sharavanan

Instructor(s) : C.M.MEENAKSHI, MR.SHARAVANAN

Name of the instructor	Class handling	Office location	Office phone	Email (domain: @bharathuniv.ac.in)	Consultation
C.M.MEENAKSHI,	Third year MECH	Sk 002		Meenakshi.mech@bharathuniv.ac.in	**9.00 to 9.500 am**
MR.SHARAVANAN	Third year MECH	Sk 003		sharavanan.mech@bharathuniv.ac.in	1.30 to 2.20 pm

Relationship to other courses

Pre-requisites : machine design –Industrial Metallurgy

Assumed knowledge : Knowledge on material science and metallurgy

Following courses : Nil

Syllabus Contents

UNIT I INTRODUCTION **9**

Conventional materials–Limitations–Definition of composite materials–Difference between conventional and composite materials-Types of Characteristics (Dispersions, particulates, fibre)-Application.

UNIT II MATERIALS **9**

Fibres-Materials-fibre reinforced plastics-Thermoset polymers-Coupling agents, fillers and additives-Metal matrix and ceramic composites-Particulate reinforced composite

UNIT III MANUFACTURING **9**

Fundamentals-bag moulding-compression moulding- pultrusion-filament winding-other manufacturing process-MMC's Casting (Solid and liquids state processing)-quality inspection and non destructive testing

UNIT IV MECHANICS AND PERFORMANCE **9**

Introduction to micro-mechanics-Unidirectional laminates-interlinear stresses-static mechanical properties-fatigue properties-impact properties-environmental effects-fracture mechanics and toughening mechanisms, damage prediction, failure modes.

UNIT V DESIGN OF COMPOSITES **9**

Failure predictions-design considerations-joint design-codes-design examples. Optimization of laminated composites-Application of FEM for design and analysis of laminated composites.

TEXTBOOKS:

1. Krishnan Chawla ,Composite Materials Science and Engineering, Springer publications,2012.
2. Daniel gay, Composite Materials, CRC Press, 3rd edition.

REFERENCES:

1. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, 1994.
2. Michael Hyer, Stress Analysis of Fiber- reinforced composite Materials, Tata McGraw Hill, 1998.

3.http://www.springer.com/in/book/9780387743646

4.https://books.google.co.in/books/about/Composite_Materials.html?id=5Q6oUTFO0RgC

Computer usage: NIL

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area : | Engineering

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	FEB 2nd WEEK	Session 1 to 14	2 Periods
2	Cycle Test-2	MARCH 2nd week	Session 15 to 28	2 Periods
3	Model Test	APRIL 3rd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications	Correlates to program outcome		
	h	m	l
Will understand concepts and working principle of heat exchangers.	a		
Will understand shell and tube type heat exchanger design.	c,i		e,k
Will able to do compact heatexchanger design.	a	f	
Will understand the concept of condenser and evaporator.	c	g	e,l
Student learns about cooling tower	i		
Student understands installation of cooling tower	a		e,l

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Lecture No.	Topic (Unit No.)	No of hrs	Solving problems	Reference Books
1	Thermal And Hydraulic design – Inner pipe – Annulus	1	YES	R1.R2
2	Hairpin heat exchanger	1	YES	R1.R2
3	Basic inner tube, Finned multi tubes	1	YES	R1.R2
4	Parallel and series arrangements	1	NO	
5	Pressure drop, Constructional features.	1	NO	
6	Heat pipes – Structures – Applications	1	YES	R1.R2
7	Basic relations – Performance characteristics,	1	YES	R1.R2
8	Effect of working fluid and operating temperatures, Wick	1	NO	
9	Selection of materials – bore size.	1	NO	

10	**Unit-II** Basic components – shell – tube bundles	1	NO	R1.R2
11	baffles – type and geometry	1	NO	
12	design procedure	1	NO	
13	preliminary estimation of size, pressure drop and Heat transfer calculations –	1	NO	
14	preliminary estimation of size, pressure drop and Heat transfer calculations	1	NO	
15	shell and tube sides –	1	YES	R1.R2
16	Kenn method – Bell – Delaware methods	1	YES	R1.R2
17	Delaware methods	1	YES	R1.R2
18	Delaware methods	1	YES	R1.R2
19	**Unit-III** Compact Heat Exchangers	1	YES	R1.R2
20	types – constructional features, heat transfer and pressure drop calculations	1	YES	R1.R2
21	Finned plate and tube.Gasketted plate Heat Exchangers	1	YES	R1.R2
22	Finned plate and tube.Gasketted plate Heat Exchangers	1	YES	R1.R2
23	constructional features plate, pack and flame	1	YES	R1.R2
24	Operational characteristics – Flow arrangements	1	NO	
25	Heat transfer and pressure drop calculations	1	NO	
26	Performance analysis	1	NO	
27	Comparison with other types of heat exchangers	1	NO	
28	**Unit-IV** Introduction	1	YES	T1
29	Shell and tube condensers	1	YES	T1
30	Horizontal and vertical types	1	YES	T1
31	Design and operational	1	YES	

	consideration,			
32	Plate condensers	1	NO	
33	Air cooled and direct contact type condenser for refrigeration, Evaporative condensers	1	NO	
34	Evaporators for refrigeration and air conditioning –	1	NO	
35	Chillers – air coolers – thermal analysis –	1	YES	T1
36	Shah, Kandhkar and Ghnkor and Winterom Correlations, Standard types.	1	YES	T1
37	**Unit-V** Cooling towers	1	NO	T1
38	Types – Basic relation	1	YES	T1
39	Heat balance and heat transfer characteristics and effect of packing	1	NO	
40	Heat balance and heat transfer characteristics and effect of packing	1	NO	
41	Geometry, Spray design,	1	NO	
42	Selection of pumps, fans	1	YES	T1
43	Testing, Maintenance	1	YES	T1
44	Environmental effects, wind load,	1	NO	
45	Typical installations.	1	YES	T1

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.
- Slide presentations and video demos.

Evaluation Strategies

		5%
Cycle Test – I	-	
Cycle Test – II	-	5%
Model Test	-	10%
Assignment / Seminar / Online Test / Quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by:

C.M.Meenakshi

ABET Outcomes expected of graduates of B.Tech / MECH / program by the time that they graduate:

a) The ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) The ability to identify, formulate and solve engineering problems.

c) The ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) The ability to design and conduct experiments, as well as to analyze and interpret data

e) The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) The ability to apply reasoning informed by the knowledge of contemporary issues.

g) The ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) The ability to understand professional and ethical responsibility and apply them in engineering practices.

i) The ability to function on multidisciplinary teams.

j) The ability to communicate effectively with the engineering community and with society at large.

k) The ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) The ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION:

Mechanical Engineering graduate sare enthusiastic to provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Mechanical Engineering.

PEO2: CORE COMPETENCE:

Mechanical Engineering graduates have competence to enhance the skills and experience in defining problems in the field of Mechanical Engineering and Technology design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:

Mechanical Engineering graduates made competence to enhance their skills and embrace new thrust areas through self-directed professional development and post-graduate training or education.

PEO4: PROFICIENCY:

Mechanical Engineering graduates became skilled to afford training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:

Mechanical Engineering graduates are morally merged to apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

BME 005 DESIGN OF HEAT EXCHANGERS

COURSE TEACHER	SIGNATURE
C.M.MEENAKSHI	
MR.SHARAVANAN	

CO-ORDINATOR **HOD / MECH**

Mr.Sharavanan